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Hydrobiology of the inshore waters off Tuticorin in the Gulf of Mannar

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Abstract

A study conducted for a period of one year (2003) on the hydrobiology of the coastal and inshore waters off Tuticorin based on samples from the surface and bottom regions of two stations, indicated a bimodal oscillation in water temperature and unimodal fluctuation in salinity. The sewage polluted first station showed comparatively lower dissolved oxygen content, higher productivity and high nutrient content. At the second station, high nitrite concentration was observed associated with monsoon season. Very high statistically significant difference ($P<0.001$) was observed in the dissolved oxygen content, productivity and nutrient concentration between the two stations. The zooplankton volume was also less both in quantity as well as in diversity at the first station. Copepods followed by Lucifer, and fish eggs were the dominant groups at both stations.

Keywords: Hydrobiology Gulf of Mannar, Tuticorin

Introduction

The hydrobiology of marine ecosystem plays an important role in predicting, locating and exploiting the marine fishery resources. The Tuticorin area under the influence of northeast monsoon constitutes a unique water body in the Gulf of Mannar along the southeast coast of India and is being rapidly affected by industrialization during the past few years. Considerable information is already available on the hydrology of the Gulf of Mannar (Marichamy and Pon Siraimeetan, 1979; Gopinathan and Rodrigo, 1991). Marichamy *et al.* (1985) have summarized the hydrology and plankton productivity in the inshore waters off Tuticorin. Apart from these studies, no recent information is available on the relative fertility of this area in terms of seasonal variation in the hydrology, primary and secondary productivity. The present investigation was carried out by studying various hydrological parameters from two stations off Tuticorin for a period of one year during 2003. Station I was at the sewage polluted fishing harbour and station II, the inshore waters.

Materials and methods

The surface and bottom water samples were collected every fortnight between 06.30 – 10.00 hours from two stations employing the research vessel *Cadalmin*-IV. The first station was fixed at 5 m depth within the vicinity of sewage polluted fishing harbour area and the second station in the inshore fishing grounds at 20m depth. *In-situ* observation on atmospheric temperature was made with a precision centigrade thermometer of 0.5^0C accuracy. Standard procedures were adopted for estimating the dissolved oxygen, salinity and inorganic nutrients (Strickland and Parsons, 1968; Parsons *et al.*, 1984). The primary production was estimated by dark and light bottle method and Winkler's method was employed for the estimation of oxygen and the same was converted for carbon equivalent using a PQ of 1.25 for obtaining the gross production. The plankton sample collections were made in 10 minute surface haul by a net of 50cm diameter and bolting net mesh size of 0.33mm by towing at a uniform speed (1knot/hr). The sample was immediately preserved in 5% formalin. The volume of plankton was measured by displacement method. The entire sample was fractioned by means of a sub sampler and the total number of organisms in one such sample was counted and estimated for the whole sample. The monthly mean values of hydrological parameters were used for further interpretations. The statistical analysis such as one way analysis of variance ANOVA was carried out using SPSS 7.5 software.

Results and discussion

***Temperature*:** There was not much variation in the atmospheric temperature at both stations and ranged between a minimum of 24.4°C during January to a maximum of 30^0C during August (Fig.1). The surface water temperature was greatly influenced by atmospheric temperature. The latter was well above the surface water temperature during November to March as reported by Prasad (1957). Not much variation was observed in the surface water temperature at both stations and ranged between 26.5°C during January and 32.5°C during May. No significant difference was observed (P>0.05) between the two stations and also between the surface and bottom waters. At both stations, the water temperature steadily increased from the lowest during winter season November-January up to April- May and then gradually declined during June to August. Again it was found to increase during September to October followed by a decline during winter season (Fig. 1). Such bimodal oscillation (two maxima and two minima) in Tuticorin waters have been reported earlier by Marichamy and Pon Siraimeetan (1979) also.

Salinity: The salinity varied between 31.2- 37.6 ppt and 29.6 - 36.2 ppt at stations I and II respectively. The value was minimum at both the stations during March and maximum during August. Coinciding with the northeast monsoon, the value was comparatively lower during November to February and gradually increased from April onwards and attained a peak during August (Fig. 2). The salinity fluctuated unimodally associated with northeast monsoon in Tuticorin waters. The difference in the salinity between the two stations and also between the surface and bottom waters were not statistically significant (P>0.05). Earlier, Jayaraman (1954) and Bapat (1955) also have reported such unimodal fluctuation in salinity in the Gulf of Mannar.

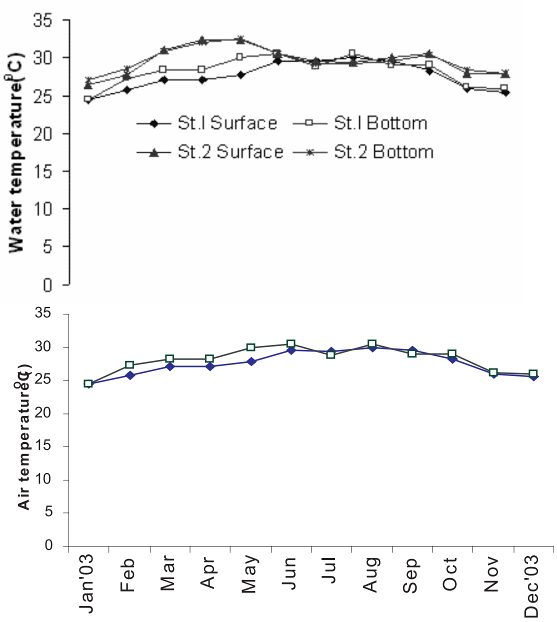

Fig.1. Monthly mean values of air and water temperatures (° C) at two stations.

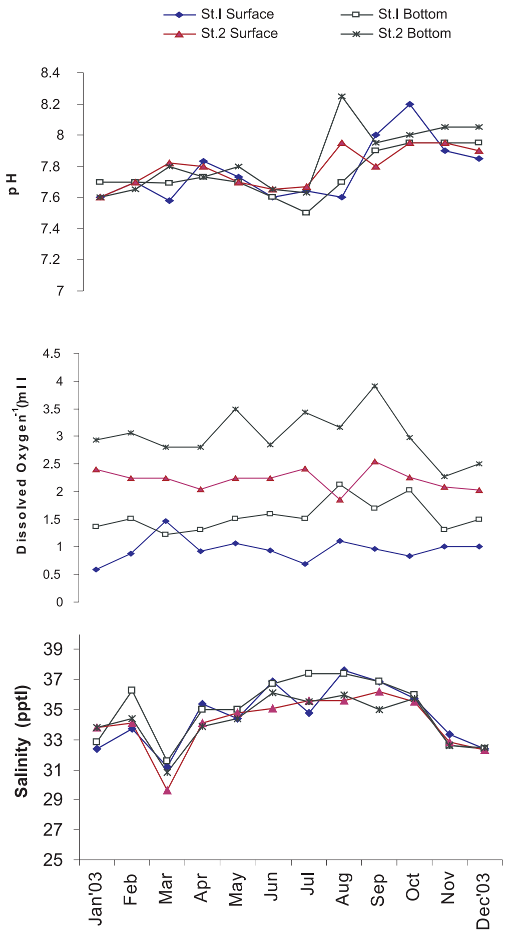

Fig.2. Monthly mean values of salinity (ppt), *p*H and dissolved oxygen content (ml l^{-1}) in the surface and bottom waters at two stations.

pH: Not much variation was observed in the *p*H between the surface and bottom waters of two stations and the value ranged between 7.5 to 8.3 (Fig.2) and the differences were also observed not significant between the two stations and also between the surface and bottom waters (P>0.05). The bimodal oscillation in the *p*H, as observed by Marichamy and Pon siraimeetan (1979) in Tuticorin waters was absent in the present study.

Dissolved oxygen content: The DO content was lower at stn.I and ranged from 0.6 ml l^{-1} to 1.5 ml l^{-1}, 1.2 to 2.13 ml l^{-1}, in the surface and at bottom compared to 1.9 to 2.5 ml l^{-1}, 2.3 ml l^{-1} to 3.9 ml l^{-1} at stn. II respectively (Fig.2). At both stations, the bottom water showed higher DO content than the surface water and the difference was highly significant (P<0.001). At second station, the mean monthly dissolved oxygen was generally lower during

March- May and high during southwest windy season. Comparatively lower value in the surface waters of the sewage polluted stn I was due to the high organic content as reported by Santhanam and Venkataramanujam (1996). A very high statistically significant difference was also observed in the dissolved oxygen content between the two stations ($P<0.001$).

Gross primary productivity and nutrients: The study indicated a wide range of fluctuations in the productivity at both stations, the difference was found to be statistically significant ($P<0.001$). At the first station, comparatively higher productivity was recorded throughout the period and ranged from 0.739 to 16.9 mg-C l^{-1} day $^{-1}$ with a mean ±SE of 5.07 ±1.45 mg-C l^{-1} day $^{-1}$ and 0.857 to 15.5 mg-C l^{-1} day $^{-1}$ with a mean ± SE of 5.9± 1.63 mg-C l^{-1} day $^{-1}$ in the case of surface and bottom waters respectively. At the other station, not much seasonal fluctuation was observed in the productivity at surface water. Generally, the bottom water was found to be more productive throughout the period and the mean ±SE value recorded was 0.985±0.295 mg-C l^{-1} day $^{-1}$ and 2.25 ±1.02 mg-C l^{-1} day $^{-1}$ in the case of surface and bottom waters respectively (Fig.3). But the difference was not statistically significant ($P>0.05$). The gross productivity observed in the present study at stn.II is comparable with that of earlier studies (Gopinathan and Rodrigo, 1991).

At I station, especially the surface water showed comparatively higher nitrite and phosphate concentration. Significant difference was observed in the nutrient concentration between the surface and bottom waters ($P<0.001$). The high rate of primary productivity at stn I might be attributed to the high nutrient concentration (Fig.4).

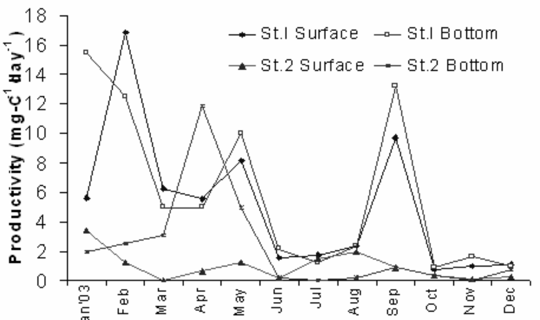

Fig.3. Monthly mean values of gross primary productivity (mg-C l^{-1} day $^{-1}$) in the surface and bottom waters at two stations

At both the stations, there was an increase in nitrite concentration during September-November, coinciding with the northeast monsoon, and phosphate during January – May. Very high significant difference was observed in the nitrite and phosphate concentration between the two stations ($P<0.001$). The silicate concentration indicated lesser fluctuations. In the present study, the high nutrient concentration observed throughout at the stn I was mainly due to the sewage pollution as indicated by Manimaran and Ramadhas (1989). At stn II there was increase in nitrite concentration during August- November which coincided with northeast monsoon, and that of phosphate from April – June. Gopinathan *et al*. (1994) also reported such seasonal fluctuation in the nitrite and phosphate concentration of the inshore waters off Tuticorin.

Zooplankton: The zooplankton composition exhibited a regular seasonal variation in Tuticorin waters. When compared to the inshore waters, at the sewage fed first

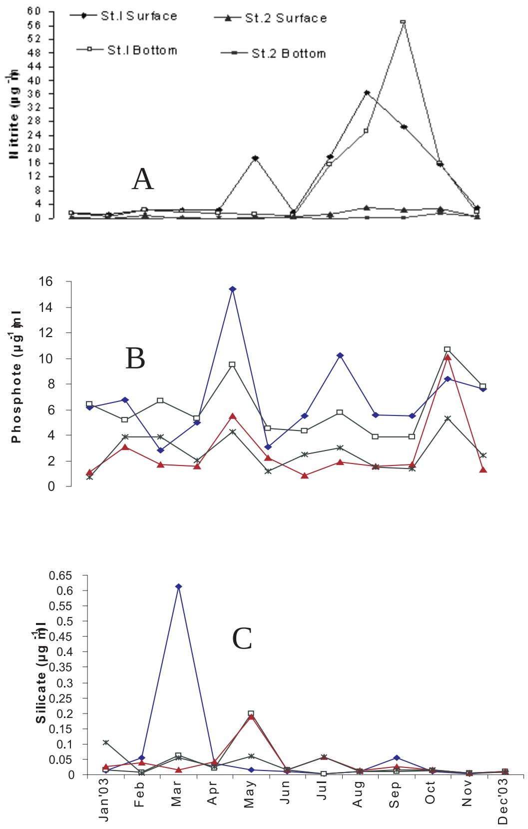

Fig.4. Monthly mean values of nutrients (µg ml^{-1}). a) nitrite, b) phosphate, c) silicate in the surface and bottom waters at two stations

station, the zooplankton settlement volume was comparatively less both in quantity as well as in diversity, but the difference was not statistically significant ($P<0.05$). At the first station, there was a decrease in the zooplankton volume during January - May, which slowly rose since June onwards and attained a peak of 30.5ml in October (Fig. 5). Copepods and lucifer constituted the major standing crops followed by fish eggs. Stray dominance of decapods in February, mysis in March, prawn larvae in November and amphipods during March were also observed. At the second station also, there was a rise in plankton volume from May which attained a maximum of 96.5ml during October, associated with monsoon. Except during June, March and April, the copepods constituted the most dominated group followed by fish eggs, lucifer, mysis, decapods and prawn larvae (Fig. 5).

The two peaks in zooplankton volume observed at both the stations, during June – October (high magnitude) and January- February (low magnitude) agreed with the findings of Marichamy *et al.* (1985). Marchamy and Pon Siraimeetan (1979) and Sreenivasan *et al.* (1985) also have indicated the same trend in Gulf of Mannar area in their studies. The increased occurrence of fish eggs during May – July indicated the possible spawning season of various fin-fishes in this area. Thus, the present observations indicated not much change in the relative fertility of Tuticorin waters especially the inshore waters from past studies. At the same time the likely impact of increased sewage pollution with in the vicinity of the fishing harbour area at stn I, warrants immediate research attention in the coastal areas.

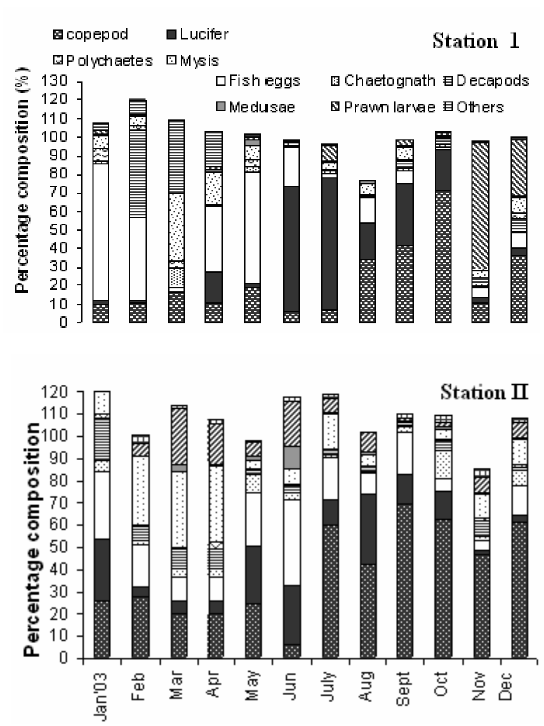

Fig. 5. Monthly mean values of percentage composition of zooplankton at St. 1 and St. 2.

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